ENGR 120 LAB #4 – Digital Components

Objectives

1) Apply Logic design and implementation skills.
2) Proficiency in requirement analysis, logic design, implementation and testing processes.

Materials

1) Introduction to ECSE textbook
2) Course website: www.EngrCS.com
3) Instruments: Power Supply and Multimeter
4) Supplies:
   a) Proto Board (1 unit)
   b) Jumper Wires (as needed)
   c) Assorted LED Colors (3 units)
   d) 1 KΩ resistor (as needed)
   e) 74LS08, 74LS32 and 74LS86

Notice: Ground and Vcc pin #s vary among the ICs so double check your schematic and design before powering your design.

Procedure

1) Keep the same lab partner as from the previous lab.

2) Lab experiments
   a) Read through the lab prior to arriving in the lab. The labs provide background information or design that can be done prior to arriving in the lab. Good preparation can minimize the time spent in the lab room and lead to a more enjoyable lab!
   b) Perform each experiment listed in the lab.
   c) Record your results and/or observations for each experiment.

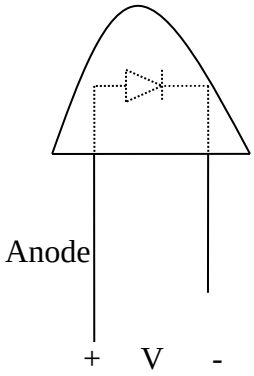
3) Report
   Reports must be created ***individually***. All reports must be computer printed (Formulas and Diagrams may be hand drawn) and at minimum include:
   a) Header:

Your name Lab # Date Team member names Experiment #1: …

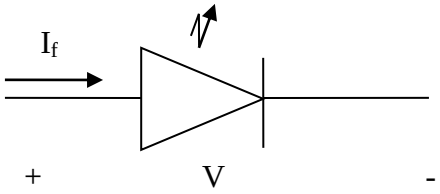
   b) For each experiment:
      i. Clear problem statement; specify items given (if any) and to be found
      ii. Document the resulting circuit design, tables, diagrams, calculations and other results
   c) For the report as a whole:
      i. Lessons learned from the experiments
      ii. Content/format improvement suggestions and reasons for the suggestions
      iii. Estimated time spent on the lab (value is not graded – used to improve labs)

Experiment 1. Connecting Switch and LED

Light Emitting Diodes (LEDs) are used as indicators in many applications from power on/off lights to traffic signal lights. LED lumination, current and power specifications vary depending on design and application. LEDs used in this lab are specified below (Lumex SSL-LX5093LXX):



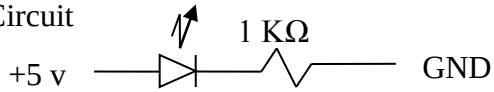
Packaging Configuration



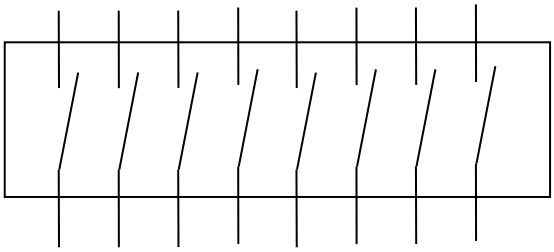
Functional Diagram

Rating: $I_f < 30$ mA at 2.5 Volts
Typical: +2.1 V at I= 5 ma

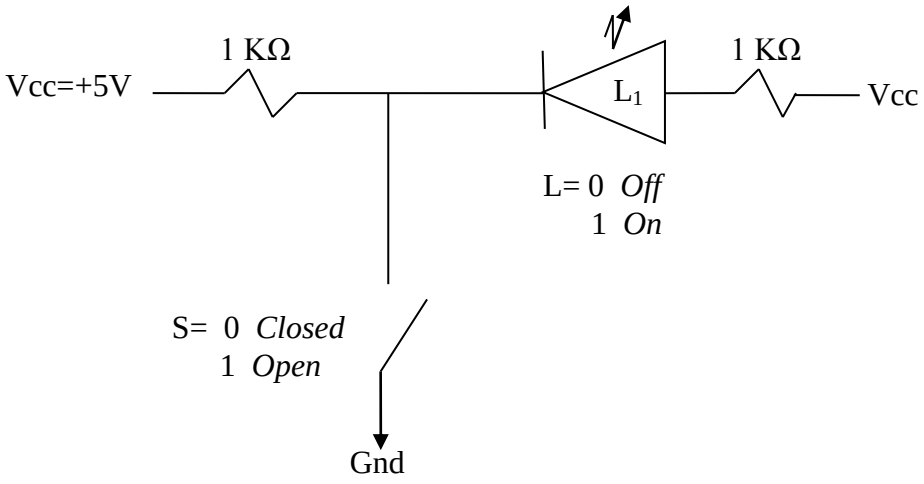
Typical Circuit



The 8-Switch Dual-In-line Packaging contains 8 switches configured as shown below:



a) Implement the following circuit and based on your observation, draw a truth table showing the relationship between LEDs (1 for on and 0 for off) and switch state (1 for open and 0 for closed).
b) Describe the operation of the circuit when the switch is open and closed. Be sure to include what the diode is doing in each case. (Hint, use the diode terms forward biased and reverse biased in your description.)



This (partial) data sheet is from: **http://www.engrcs.com/components/74LS08.pdf**

National Semiconductor

June 1989

54LS08/DM54LS08/DM74LS08 Quad 2-Input AND Gates

General Description

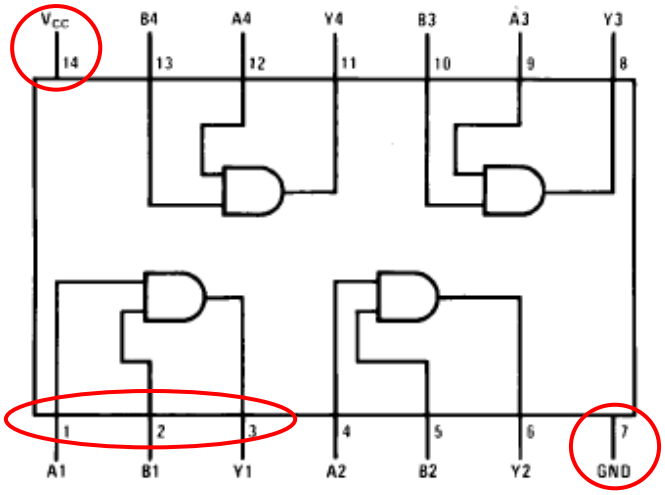
This device contains four independent gates each of which performs the logic AND function.

Features

- Alternate Military/Aerospace device (54LS08) is available. Contact a National Semiconductor Sales Office/ Distributor for specifications.

Connection Diagram

Dual-In-Line Package



TL/F/6347–1

Order Number 54LS08DMQB, 54LS08FMQB, 54LS08LMQB, DM54LS08J, DM54LS08W, DM74LS08M or DM74LS08N
See NS Package Number E20A, J14A, M14A, N14A or W14B

Function Table

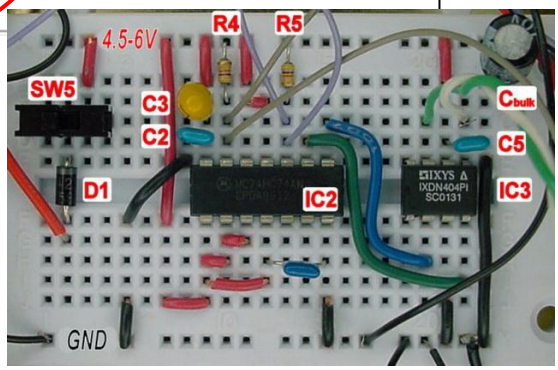
$Y = AB$

Inputs		Output
A	B	Y
L	L	L
L	H	L
H	L	L
H	H	H

H = High Logic Level
L = Low Logic Level

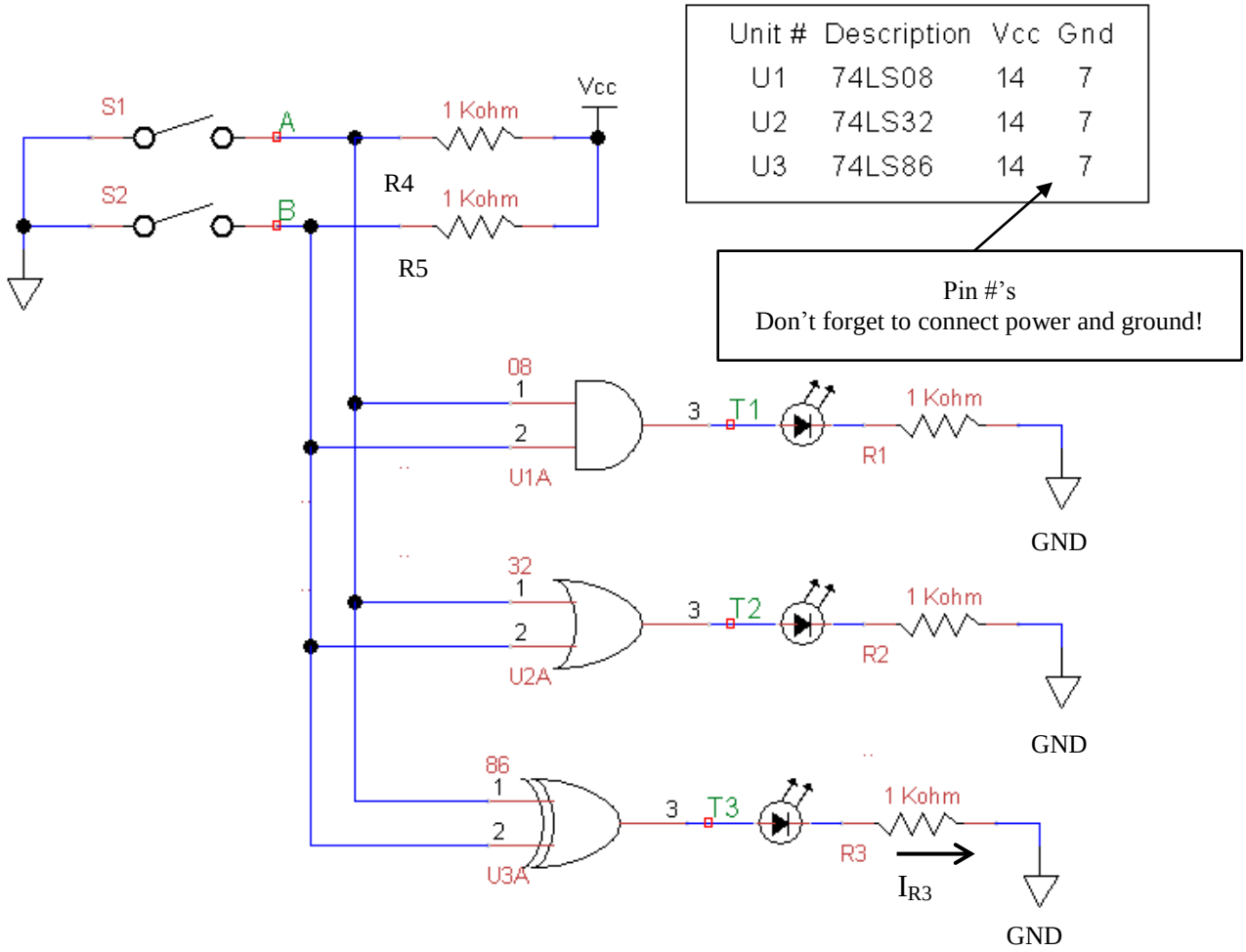
54LS08/DM54LS08/DM74LS08 Quad 2-Input AND Gates

And here is an example of a circuit implemented on a proto board. Notice how well organized the wires and components are. Fixing problems on this circuit is easier than circuits with long wires crossing over other parts.



Experiment 2. Logic Gate Properties

Construct the following circuit on a protoboard. Recall that Vcc is +5V from the power supply.



a) When switch S1 is open, measure the voltage of signal A.*

b) When switch S1 is closed, measure the voltage of signal A.*

c) Cycle through all four combinations of S1 and S2 to create a truth table for each of the gates. The inputs are A and B, and the outputs are T1, T2, and T3.

d) When the LED for T1 is illuminated (on), what is the voltage of the logic gate output (U1A pin 3)?

e) When T3 is on, measure the voltage drop across R3. Now using that voltage drop measurement, calculate the current I_{R3}?

Now if you were designing this circuit, you would need to ensure that the value of R3 restricted the current flow to not damage the LED or the logic gate.

*MEASUREMENT TECHNIQUE:

A voltmeter has two probes, typically a black probe (for Common) and a red probe. Sometimes you will want to measure the voltage drop across a device, and for this measurement you would put the probes on each end of the device. For example, to measure the voltage drop across R3 in the circuit above, connect the black probe to the right (GND) side of R3 and the red probe on the other side of R3.

Other times the statement, "measure the voltage of Signal A, or output U3 pin 3". Statements such as these infer that the Common/Black probe is connected to GND and the red probe is connected to the desired measurement point. Either on Signal A, or pin 3 of U3.